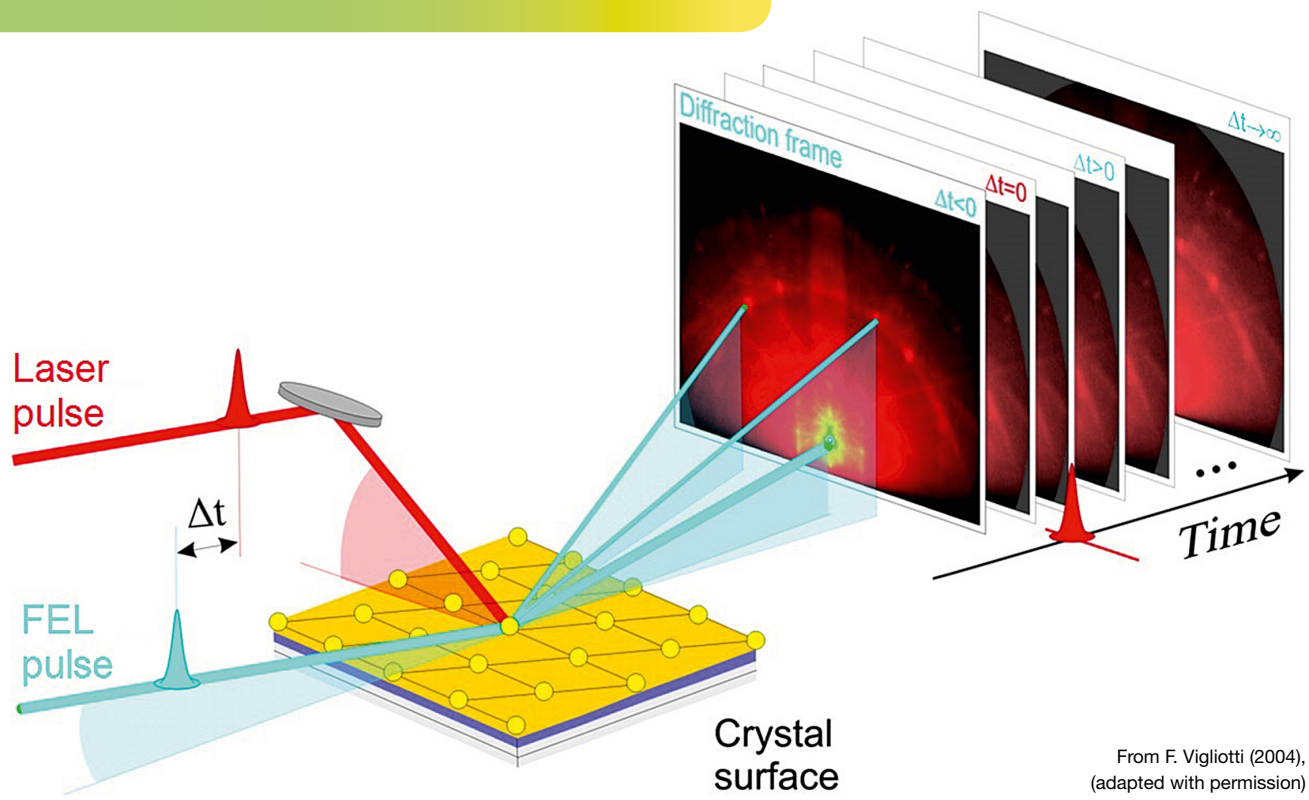
ADVANCED PHOTON BEAM DIAGNOSTIC TOOLS



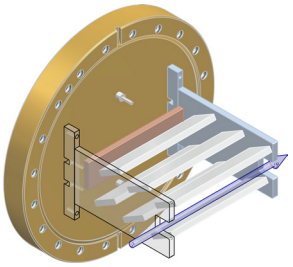
From F. Vigliotti (2004), (adapted with permission)

Each of EUCALL's facilities produce intense, ultra-short x-ray pulses whose characteristics change to some extent from pulse to pulse. It is essential to diagnose the light pulses shot-to-shot, non-invasively.

X-ray Gas Intensity Monitor

The intensity of the photon beams at European XFEL and ELI Beamlines span several orders of magnitude. A »huge aperture open multiplier« (HAMP) will be introduced to the gas monitor detector of DESY's FLASH FEL to measure the intensity of the beams at each new facility, which can operate at pulse repetition rates of up to 4.5 MHz.

Conceptual drawing of the »Huge Aperture Amplifier« (HAMP) detector. Several dynode stages made of solid CuBeO alloy will amplify incident charged particles of the photoionised target gas.



EUCALL

Pulse Characterisation and Control – PUCCA

The European Cluster of Advanced Laser Light Sources

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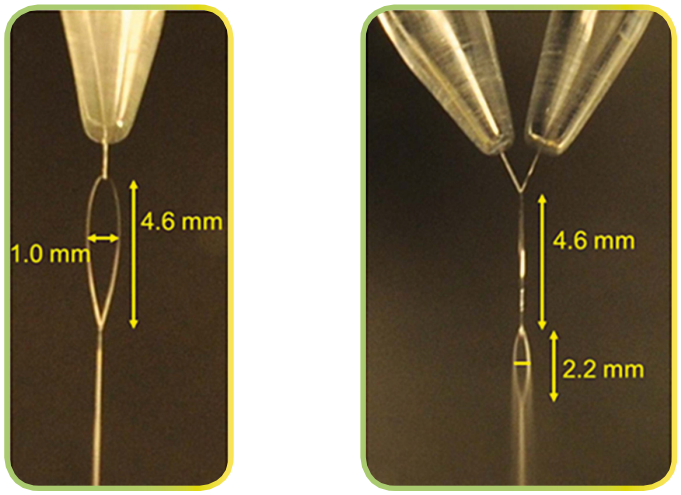
Femtosecond Resolved Pulse Arrival Time Tools

A thin flat sheet of a liquid jet can serve as a moving target for determining the relative arrival time of laser and x-ray pulses with femtosecond time resolution. The linear flow speed of the liquid needs to be about 100 µm/µs to accommodate the high intra-train repetition rate of 4.5 MHz of the European XFEL, such that the sample volume is replaced for each pulse in the train.

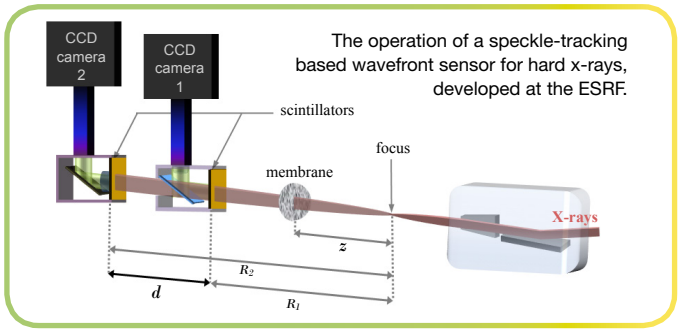
A second approach is to make use of intense THz radiation generated e.g. at the exit of the last undulator to drive an electro-optic sampler, which is transmitted by an extremely chirped white light pulse from the second laser source.



Photographs of a liquid flat sheet from two orthogonal directions showing the formation of a first sheet (left picture) and a second, smaller one below at an angle of 90 deg (From Ekimova, M. et al. A liquid flatjet system for solution phase soft x-ray spectroscopy. Structural Dynamics 2, 2015).

X-ray Wavefront Sensor

The spatial position and wavefront shape of x-rays passing through beamline optics vary from pulse to pulse. When the coherent beam passes through the scattering membrane, speckle is generated. Images of this speckle are captured simultaneously at two distinct cameras and the analysis of each pair of images allows to reconstruct the pulse wavefront and monitor its evolution.



The operation of a speckle-tracking based wavefront sensor for hard x-rays, developed at the ESRF.

EUCALL is a network between leading large-scale user facilities for free-electron laser, synchrotron and optical laser radiation and their users. Under EUCALL, they work together on their common methodologies and research opportunities, and develop tools to sustain this interaction in the future. EUCALL has received funding from the European Union's Horizon 2020 research and innovation programme and involves 11 partners from nine countries as well as the networks Laserlab Europe and FELs of Europe during the project period 2015 to 2018.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654220.

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